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[54] **REFRIGERANT RECOVERY AND RECYCLING ASSEMBLY**

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[51] **Int. Cl.**[5] **G01K 13/00**

[52] **U.S. Cl.** **62/129**; 62/292; 62/149; 62/475; 62/470

[58] **Field of Search** 62/77, 85, 129, 149, 62/292, 474, 475, 470; 73/23.23, 29.03, 31.03, 64.2

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,149,358	3/1939	Miller	62/470
3,212,284	2/1964	Henderson et al.	62/149
3,232,070	2/1966	Sparano	62/149
4,261,178	4/1981	Cain	62/149
4,285,206	8/1981	Koser	62/149
4,363,222	12/1982	Cain	62/149
4,476,688	10/1984	Goddard	62/149
4,539,817	9/1985	Staggs	62/149
4,646,527	3/1987	Taylor	62/149
4,768,347	9/1988	Manz et al.	62/149
4,805,416	2/1989	Manz et al.	62/292
4,809,520	3/1989	Manz et al.	62/292
4,862,699	9/1989	Lounis	62/292
4,878,356	11/1989	Punches	62/149
4,903,499	2/1990	Merritt	62/149
4,934,390	6/1990	Sapp	62/77

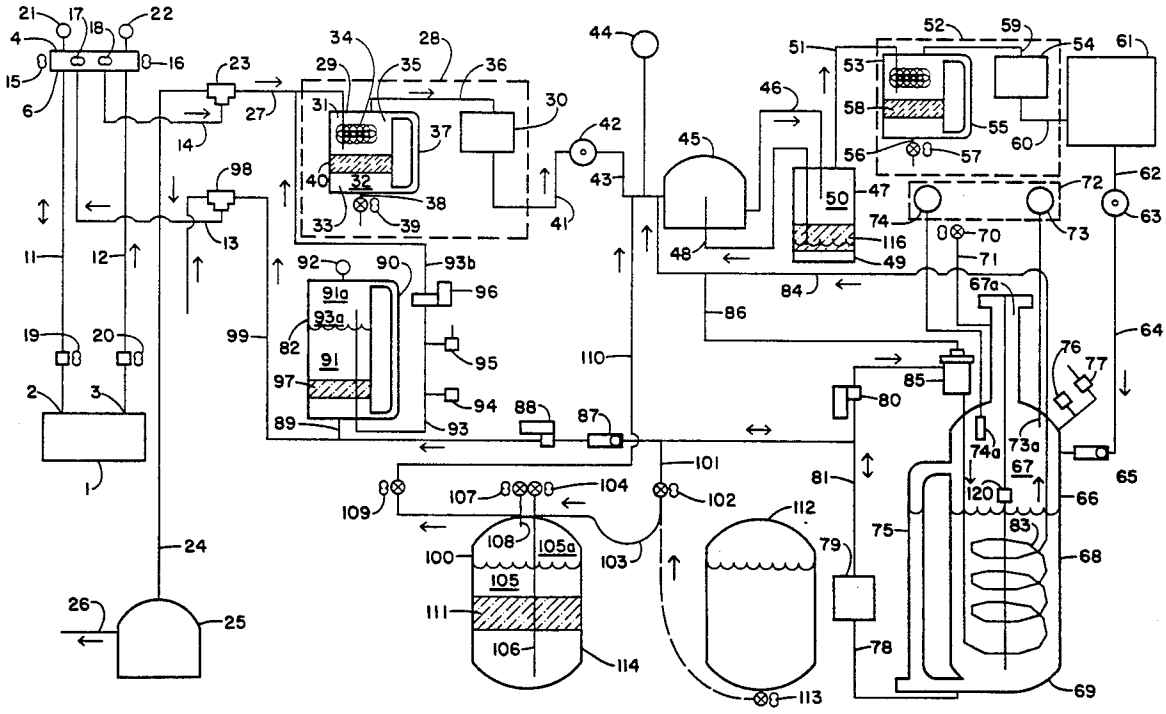
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[57] **ABSTRACT**

An apparatus for recovering and recycling used refrigerants from automotive air conditioning systems and similar air conditioning systems is disclosed having a unique cleaning assembly, a unique coolable storage means, and for recharging recycled refrigerant a unique metering means, as well as gauge assembly for measuring the amount of gas contaminates in the used refrigerants.

51 Claims, 3 Drawing Sheets



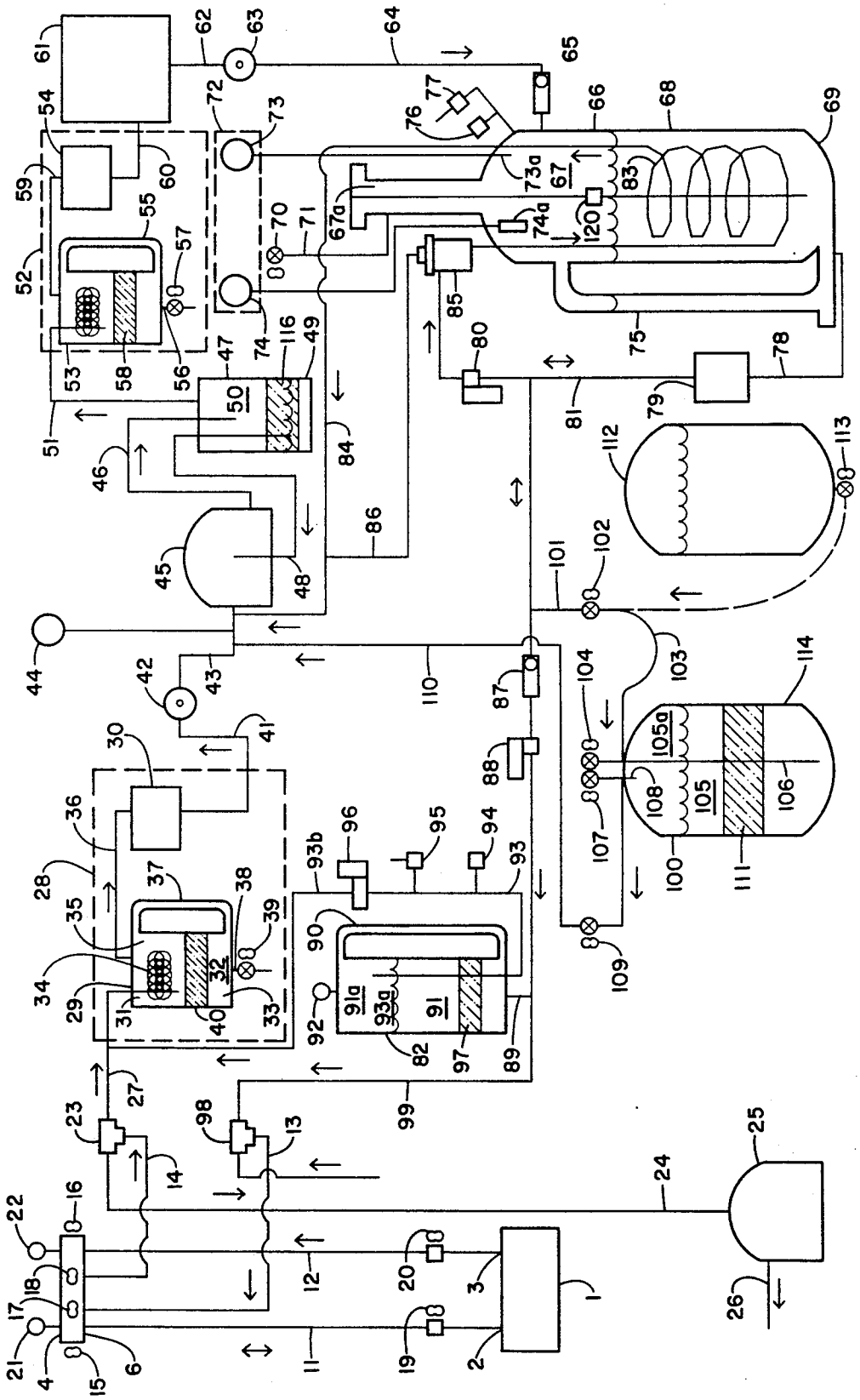


FIGURE 1

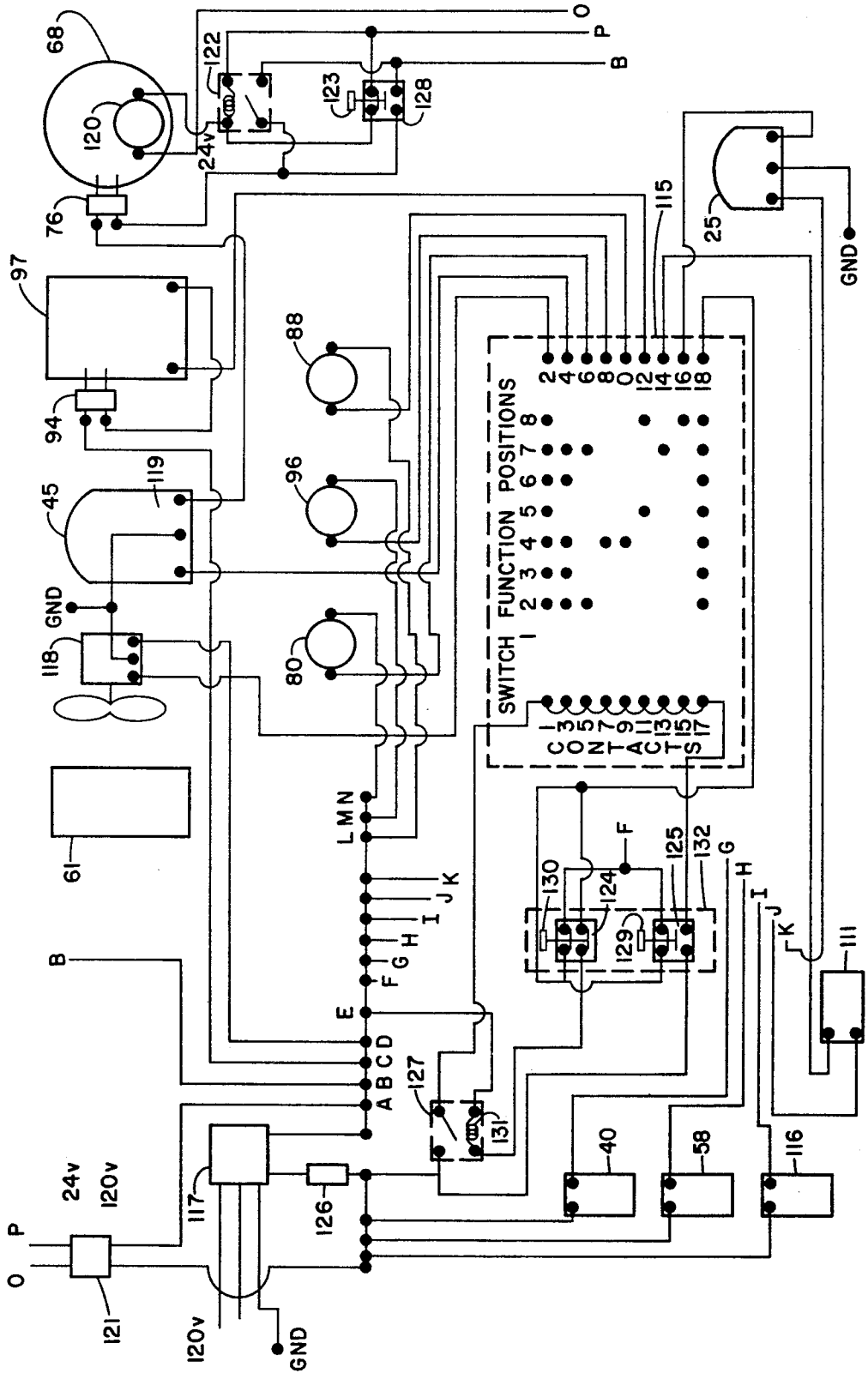

SWITCH FUNCTION POSITIONS
1 2 3 4 5 6 7 8
CONTACTS
1 3 5 7 9 11 13 15 17
2 4 6 8 10 12 14 16 18
GND
24v
120v
O
P
B
A B C D E F G H I J K L M N

FIGURE 2

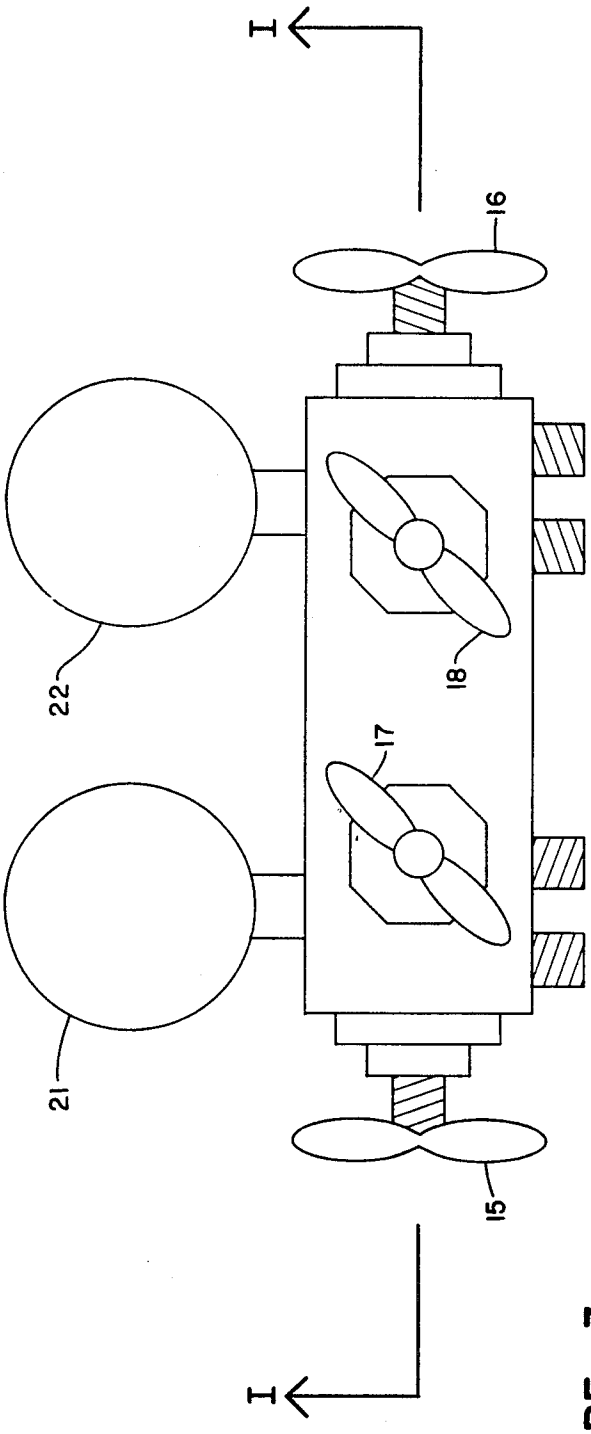


FIGURE 3

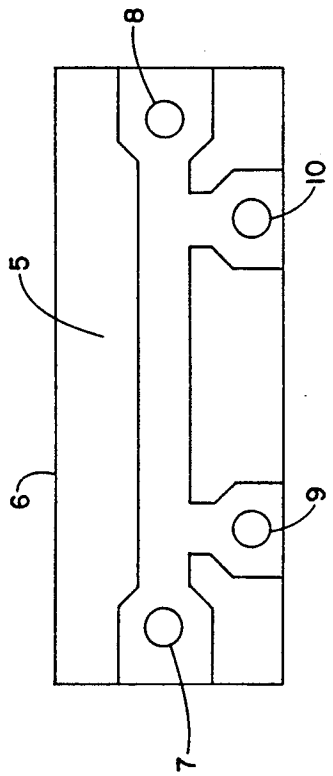


FIGURE 4

REFRIGERANT RECOVERY AND RECYCLING ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to devices which can recover and recycle, or recover, recycle and recharge refrigerants, and more particularly to a device which can recover, recycle and recharge refrigerants such as R-12 from air conditioning systems used in automobiles, trucks and similar vehicles.

2. Prior Art

With the recognition of the importance of the ozone layer in the Earth's atmosphere, and that chlorofluorocarbons (CFC) which were being emitted into the atmosphere were primarily responsible for the depletion of the ozone layer, concerted efforts have been and are being made to reduce the amount of CFC being emitted into the atmosphere.

One major source of CFC being emitted into the atmosphere is the refrigerant R-12 used in air conditioning systems found in automobiles, trucks and other vehicles. As a result of the recognition of this particular problem various standards have been set by both Underwriters Laboratories (UL) and the Society of Automotive Engineers (SAE) for the procedure and equipment characteristics to be used in the recovery and purification of R-12 in refrigerant systems, rather than to simply vent the used refrigerant to the atmosphere. To comply with these standards industry has designed and currently markets a multitude of recovery and recycling systems for R-12.

As used herein the term "recycled refrigerant" shall mean used refrigerant that has been cleaned of oil, moisture, solids and non-condensible gases to the extent necessary to meet the current UL published safety standards set forth in UL 1963 entitled "Standard for Safety Refrigerant Recovery/Recycling Equipment" and the current SAE published standards set forth in J1989 entitled "Service Procedure for Containment of R-12", J1990 entitled "Extraction and Recycle Equipment for Mobile Automotive Air Conditioning Systems" and J1991 entitled "Reclamation of R-12 Used in Mobile Air Conditioning Systems for Cleanliness".

The following are illustrative of commercial systems which process used refrigerant to produce recycled refrigerant: Wynn's Climate Systems, Inc.'s Refrigerant Recovery/Recycle System Model 9001A; SPX Robinair Division's Refrigerant Recovery and Recycling Station Models 17200, 17400, and 17500; Van Steenburgh Engineering Laboratories, Inc.'s Refrigerant Reclaim System Models Series LV and Series JV; K-Whit Tools, Inc's White Industries Division Refrigerant Recovery Recycling Center Models 01050 and 04000; Standard Motor Products, Inc.'s Four Seasons Division Refrigerant Recovery and Recycling Center Model 59870; and Refrigerant Technologies, Inc. Model RRC 1000.

In addition to the commercial products the following U.S. patents are also illustrative of the state of the art in refrigerant recovery and recycling of R-12 and other similar refrigerants: 3212284; 3232070; 4261178; 4285206; 4363222; 4476688; 4539817; 4646527; 4768347; 4805416; 4809520; 4878356; and 4903499.

Although these prior art devices can recover and recycle R-12 and other similar refrigerants, and some recover, recycle and recharge R-12, their design does not allow for the control desired when in use under actual commercial conditions. Many of these devices do not allow for easy and accurate determination that sufficient amounts of non-condensible material present in the used refrigerant have been removed. Others do not allow for the purging of air vapor that may be in the recycled refrigerant prior to being recharged to the automobile, truck or other vehicle air conditioning system. Still others are too temperature sensitive in the transferability of the refrigerant within the device. Others have no control of the level of refrigerant in the collection tank. Further problems with many of the prior art devices is control of the different procedures that can take place during the recover Another problem is the ability to accurately recharge the correct amount of recycled refrigerant back to the air conditioning system.

OBJECTS AND SUMMARY OF THE INVENTION

Therefore, it is an object of this invention to provide an assembly which has process flexibility during the refrigerant recovery and recycling operation, or refrigerant recovery, recycling and recharging operations.

Another object of this invention is to provide means for easy and accurate determination of the amounts of non-condensible gases present in the recycled refrigerant.

Still another object of this invention is to provide for the means to purge air vapor from recycled refrigerant with a minimum loss of refrigerant vapor.

A further object of this invention is to provide means to allow transferability of recycled refrigerant from a main storage tank to a recharging tank even when the pressure in the recharging tank is greater than in the main storage tank.

A still further object of this invention is to provide means to accurately determine and control the level of the recycled refrigerant in the main storage tank, as well as determine the amount of refrigerant recovered from each system. 1 Another object of this invention is to provide means to accurately recharge the correct amount of recycled refrigerant to an air conditioning system.

Other objects and advantages of this invention will become apparent from the ensuing descriptions of the invention.

Accordingly, an assembly to recover and recycle refrigerant from an air conditioning system is provided comprising (a) a first cleaning assembly having (i) an oil separator operatively connectable to the air conditioning system to receive contaminated refrigerant from the air conditioning system and structured to remove oils from the contaminated refrigerant, and (ii) a filter means operatively connected to the oil separator to receive the treated refrigerant from the oil separator and structured to remove solid particles and moisture from said treated refrigerant to form the cleaned refrigerant gas stream; (b) a compressor, having a compression chamber with a low pressure inlet and a high pressure outlet, operatively connected at said low pressure inlet to the filter means to cause the used refrigerant to pass through the filter means, and then to cause the cleaned refrigerant gas stream to pass through the low pressure inlet into the compression chamber, and structured to compress the cleaned refrigerant gas stream to form a cleaned refrigerant high pressure gas stream and to force the

cleaned refrigerant high pressure gas stream out of said compression chamber through the high pressure outlet; (c) a condenser operatively connected to the compressor to receive the cleaned refrigerant high pressure gas stream and having cooling means to condense the cleaned refrigerant high pressure gas stream to form a liquid cleaned refrigerant containing stream; and (d) means operatively connected to the condenser to receive the liquid cleaned refrigerant containing stream in a manner to remove gas contaminates from the liquid cleaned refrigerant containing stream to form liquid recycled refrigerant.

In an alternate embodiment the storage means comprises both a tank forming a cavity and an attached tank cooling means for cooling the cavity.

In another alternate embodiment the assembly includes a metering means structured for receiving recycled refrigerant from the storage means and for discharging it at a pre-determined density to an air conditioning system in a pre-determined amount.

In a further alternate embodiment the assembly includes a gauge assembly attached to the storage means and having (i) one gauge to measure and visually display the amount of the actual pressure in the storage means cavity and (ii) a bulb-capillary temperature gauge whose capillary system is filled with the same type of refrigerant being recycled to measure the actual temperature in said cavity and having a recording means converted to visually display a pressure reading associated with the actual temperature measured by the bulb-capillary temperature gauge.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic representation of preferred embodiments of the invention illustrating the hydraulics of the system.

FIG. **2** is a schematic representation of preferred embodiments of the invention illustrating the electrical connections utilized in the system illustrated in FIG. **1**.

FIG. **3** is a frontal view of a preferred four valve manifold and gauge assembly employed in the invention.

FIG. **4** is a cross-sectional view taken along lines I—I of FIG. **3** illustrating the cavity and connecting passageways of the four valve manifold assembly used with this invention.

PREFERRED EMBODIMENTS OF THE INVENTION

Turning now to FIG. **1** an air conditioning system **1** having a low pressure port **2** and a high pressure port **3** is depicted by the dashed lines. Attachable by conventional means to air conditioning system **1** is a conventional four valve manifold assembly **4** (see FIGS. **3** and **4**) to allow used refrigerant to be removed through port **2** and/or port **3** to a cavity **5** in manifold body **6** or to charge new or recycled refrigerant from cavity **5** to air conditioning system **1** through port **3**. In addition to this refrigerant flow configuration it is preferred that manifold assembly **4** be structured to allow, if desired, refrigerant flow from cavity **5** to port **2** or refrigerant flow from port **3** to cavity **5**. An example of a four valve manifold assembly **4** that can be used is Imperial Eastman Model No. 621C.

More particularly, manifold assembly **4** is structured so that manifold body **6** has four sealable passageways **7–10**, each connecting cavity **5** to one of four refrigerant flow lines **11–14**. In a preferred embodiment operatively attached to each flow line will be conventional valves **15–18**, respectively.

In a more preferred embodiment refrigerant flow lines **11** and **12** are each provided with a second conventional valve **19** and **20**, respectively, positioned near that end of refrigerant flow lines **11** and **12** that operatively connect to ports **2** and **3**, respectively.

In a still more preferred embodiment manifold assembly **4** conventional pressure gauges **21** and **22** are operatively connected to measure and read any pressure which may exist in flow lines **11** and **12**, respectively. Used refrigerant will flow from passageway **10** through line **14** to three-way valve **23** and through line **27** to a first cleaning assembly as which comprises an oil separator **29** and a filter dryer **30**.

The oil separator **29** comprises a hollow container **31** having a cavity **32**. Line **27** extends to the lower area **33** of cavity **32** and into which area the used refrigerant enters. Steel wool **34** or equivalent matter is positioned in the upper area **35** of cavity **32** to prevent any oil that may be in the used refrigerant from escaping cavity **32**. The gaseous used refrigerant exits cavity **32** through line **36**. In a preferred embodiment a sight glass **37** will be operatively connected to container **31** to allow visual observation of the amount of oil that is trapped in oil separator **29**. When the amount of oil reaches a predetermined level it may be drained from cavity **32** through line **38** by opening drain valve **39**. In another preferred embodiment a heating band **40** may be wrapped about lower cavity area **33** to aid in the separation of the oil from the gaseous refrigerant by raising the temperature in oil separator **29** to boil off the refrigerant vapor.

The oil scrubbed refrigerant passes through line to a conventional filter dryer **30** wherein solid particles and moisture (includes both water and acid) that may be contained in the refrigerant is removed. The dried, oil scrubbed refrigerant exits filter dryer **30** through line **41** to which a moisture indicator **42** is operatively attached to determine if filter dryer **30** is saturated with moisture and needs to be replaced. The refrigerant continues past moisture indicator **42** through line **43** to which a compressor suction pressure gauge **44** is operatively attached to visually indicate the refrigerant pressure before it enters the suction side of compressor **45**. In compressor **45** the refrigerant is compressed before it exits through line **46** and is passed through a compressor protective oil separator **47** to remove most of the oil which the refrigerant may have picked up in compressor **45**. In a preferred embodiment a return line **48** will allow in a conventional fashion any oil collected at the bottom area **49** of cavity **50** of the oil separator **47** to be returned to compressor **45** for reuse. In another preferred embodiment heater band **116** is positioned about bottom area **49** to insure that the refrigerant is boiled out of the entrapped oil that collects in bottom area **49**.

The gaseous refrigerant exits from the top of cavity through line **51** and passes through a second cleaning assembly **52** having an oil separator **53** and filter dryer **54** connected by line **59** like those in the first cleaning assembly **28** described above. As before it is preferred that oil separator **53** be provided with a sight glass **55** for visually determining if an upset condition exists since it is not desirable that any oil should ever accumulate in the bottom of the oil separator **53**. Also it is preferred that oil separator **53** be provided with a drain line **56** which will allow any oil that has accumulated in the bottom of the oil separator **53** to be drained out by

opening drain valve **57**. It is further preferred that a heating band **58** be positioned about the lower section of oil separator **53** as described above.

The refrigerant exits filter dryer **54** through line **60** and passes through a conventional condenser **61** wherein it exits condenser **61** as a liquid through line **62**. It is preferred that a moisture indicator **63** be operatively connected to line **62** to determine if there is any moisture contained in the liquid refrigerant. If there is this would be an indication of an upset condition, such as failure to timely replace filter dryer **30** and the subsequent saturation of filter dryer **54**. Timely replacement of filter dryer **30** should obviate the need to ever replace filter dryer **54**. The liquid refrigerant continues past moisture indicator through line **64** and check valve **65** wherein it preferably enters into the upper area **66** of cavity **67** of sealable tank **68**. Check valve **65** prevents refrigerant in cavity **67** from flowing back out and into line **64**. The liquid refrigerant which has now been purified, except of non-condensibles such as air, is collected at the lower area **69** of refrigerant collection tank cavity **67**. A portion of the air, or other non-condensibles, which may be in the refrigerant will collect in a less turbulent zone **67***a* of cavity **67** located in upper area **66** until an equilibrium is reached in cavity **67**. At this point purge valve **70** is opened and the air in zone **67***a* escapes through line **71** to the atmosphere. The purge valve **70** is then closed. As equilibrium is again achieved in cavity **67**, any additional air that may be entrapped with the vapor and/or liquid refrigerant will rise to zone **67***a* wherein it can then be purged as before. This procedure can be repeated as often as necessary to remove the desired amount of non-condensibles to meet the UL and SAE standards. Present UL safety standards and SAE standards require that sufficient non-condensibles be removed so that the vapor pressure of all recycled refrigerant not be greater than **10** psig above the vapor pressure of certified pure refrigerant. To assist in monitoring the amount of air or other non-condensibles remaining in the refrigerant in tank **68** is a gauge assembly **72** comprising a tank pressure gauge **73** and tank bulb-capillary gauge **74** which preferably are positioned so that their sensing means **73***a* and **74***a* take readings from the same level in cavity **67**. In a preferred embodiment sight glass **75** is operatively connected to tank **68** to assist in monitoring the amount of liquid refrigerant in tank **69**. In a preferred embodiment tank **68** is provided with a conventional pressure limiting device **76** to shut down operation of the compressor **45** when the pressure in tank **68** exceeds a pre-determined level, and a pressure relief valve **77** to prevent the pressure within tank **68** from exceeding a predetermined pressure that is higher than the pre-determined pressure for the pressure limiting device **76**. More particularly tank **68** is provided with float switch **120** positioned in cavity **67** that is electrically connected to relay **122** to shut down operation of the compressor **45** when a predetermined liquid level has been reached. A by-pass switch **128** and red lamp switch are electrically connected to relay **122** to first warn the operator the predetermined liquid level has been reached and second to permit by activating red lamp switch **123**, if needed, the momentary override of the shutdown of compressor **45** to allow the transfer of liquid refrigerant into or out of tank **68** depending on whether float switch **120** was activated by a low level or a high level condition.

The novel gauge assembly **72** of this invention allows the quick and accurate determination of the presence of non-condensibles in cavity **67** by showing an elevated vapor pressure greater than certified pure refrigerant would show. Tank pressure gauge **73** measures the actual pressure within tank **68**. The bulb-capillary gauge **74** is of a conventional temperature capillary gauge construction, but whose capillary tube has been filled with certified pure refrigerant of the same kind of refrigerant that is being recycled. In addition the visual recorder of gauge **74** has been modified to directly read the corresponding pressure of the tank as if it contained certified pure refrigerant. Thus, to meet the UL and SAE standards the difference in the reading from the two gauges should be less than 10 psig when tank **68** has been purged sufficiently to remove most of the non-condensibles.

This gauge assembly **72** will work with any refrigerant including R-12, R-22, R-500, R-502, R-134*a* or ammonia. When a visual recorder is used to test for non-condensibles in R-12, the scales are preferably set to read from 0–300 psig in order to provide better visibility. This range will vary depending on the particular refrigerant used. In another embodiment the readings from each of the gauges **73** and **74** could be electronically inputted into a calculating device, such as a computer, and the difference in readings visually displayed. In this embodiment the operator would not need to subtract the reading of one gauge from that of the other to obtain the difference. If this calculation is not electronically done, then it is preferred that each of the visual recorders of the gauges **73** and **74** be positioned adjacent one another on the control panel of the refrigerant purification unit to facilitate a quick and accurate reading of the gauges.

Recycled refrigerant is drawn from the lower area **69** of tank **68** through line **78** and into a two-way filter dryer **79** to insure that no solid particles or moisture will be permitted to flow through line **81**. If the recycled refrigerant is to be returned to the air conditioning system **1** it will pass through line **81** to charging cylinder **82** as described below. However, it may be desirable to run part of the recycled refrigerant in tank **68** back into cavity **67** through evaporator coils **83** and then to compressor **45** through line **84**. In this manner the refrigerant can be used on hot days to cool tank **68** before used refrigerant is removed from air conditioning system **1** in order to enable compressor **45** to draw down the air conditioning system **1** to zero psig as well as to prevent compressor overload or burn out. In addition if a portion of the refrigerant is run through evaporator coils **83** this will enhance non-condensible gas separation from both the liquid and vapor phase of the refrigerant that is in tank **68**. In using the recycled refrigerant for these two purposes, it passes through solenoid valve **80** and then to an expansion valve **85** before passing through evaporator coils **83**. It is preferred that an external equalizer line **86** (shown by dotted lines) connect line **84** near the suction side of compressor **45** and expansion valve **85** to insure that the proper pressure differentials exist to allow the proper operation of the expansion valve over the complete range of ambient temperatures encountered in operation.

Recycled refrigerant in line **81** passes through check valve **87** and solenoid valve **88** into charging cylinder **82** via line **89**. Charging cylinder **82** is provided with a sight glass **90** to enable one to determine the liquid level of refrigerant in cavity **91** of cylinder **82**. A pressure gauge **92** is operatively attached to cylinder **82** to measure the pressure within cavity **91**. In the event pressure

within cavity **91** exceeds a pre-determined level, the pressure may be reduced by allowing gaseous refrigerant to be bled from cavity **91** through pressure relief valve **95** via line **93**. Line **93** has one end **93***a* opening above the liquid level of the refrigerant in the upper area **91***a* of cavity **91** and being operatively connected to pressure relief valve **95**. In addition pressure limiting device **94** is operatively connected to line **93** to electrically shut off heater **97** when a lower pre-determined pressure is exceeded Line **93** has section **93***b* that connects opening **93***a* to line **27** at a position before the first cleaning assembly **28**. Flow through line **93** is controlled by solenoid valve **96**.

For safety purposes charging cylinder **82** should not be filled with liquid to more than 80% of its liquid volume capacity. In the event of such an occurrence, line **93** can be utilized to draw by compressor **45** such excess liquid refrigerant from the upper area **91***a* of cavity **91** and discharge it into line **27**.

In a more preferred embodiment heater band **97** will wrap about cylinder **82** to maintain the pressure within cavity **91** at the desired level to allow accurate charging of the refrigerant into air conditioning system **1** over a wide range of ambient temperatures. For vehicle air conditioning systems using R-12 refrigerant the desired pressure will be reached if the temperature in cylinder **82** is above the highest practical ambient temperature of the vehicle being repaired, preferably about 112° F.

Prior to recharging, any air or moisture that may be in air conditioning system **1** is recovered by activating vacuum pump **25** which pulls the moisture and air from port **2** and/or port **3**, through lines **11** and/or **12**, through passageway **10**, through line **14** to three-way valve **23** which has been set to allow the air and moisture to be sucked through line **24**, through vacuum pump **25**, and out line **26** to the atmosphere.

When the proper amount of liquid recycled refrigerant is in charging cylinder **82** and the pressure within cavity **91** is at the desired level, then three way valve **98** is opened to allow flow from line **89**, through line **99** and three-way valve **98** into line **13**. The valves **17**, **16** of manifold assembly **4** have been opened, along with shutoff valve **20** to allow the recycled refrigerant to enter port **3** of air conditioning system **1**.

A further benefit of the preferred connection between manifold **4** and three-way valves **23** and **98** is that by providing for use of line **14** for the used refrigerant recovery operation and for use of separate line **12** for charging recycled refrigerant, contamination of recycled refrigerant by used refrigerant is prevented.

In alternate embodiments of this invention recycled refrigerant from tank **68** may be sent to a refillable auxiliary tank **100**. Unless activated solenoid valves **80** and **88** will cause the recycled refrigerant to flow from tank **68** through line **81** to tank **100**. More particularly recycled refrigerant will pass through line **78** and two-way filter dryer **79** into line **81** and then into line **101** and through shut off valve **102** which has been opened, and finally via line **103** through tank valve **104** into the bottom area of cavity **105** via line **106**. Tank **100** is provided with a second tank valve **107** which allows gaseous refrigerant from the upper area **105***a* of cavity **105** to exit via line **108**, through shut off valve **109** and line **110** to enter line **43** leading to the suction side of compressor **45**. In a preferred embodiment heater band will be operatively attached to tank **100** to heat the refrigerant inside cavity **105** to achieve the desired pressure within cavity **105** to facilitate the transfer of refrigerant out of tank **100**.

It could be possible to design the system so that refrigerant in tank **100** can be used to charge cylinder **82**. However, it is preferred because of the similar sizing of tanks **100** and **68** and because of possible off-spec refrigerant in tank **100** that the refrigerant in tank **100** be used to first charge tank **68** and then use tank **68** to charge cylinder **82**. In this manner two-way filter dryer **79** will remove moisture and solids from the refrigerant in tank **100** before it enters tank **68**, and then again when refrigerant is transferred from tank **68** to charging cylinder **82**.

In another alternate embodiment a non-refillable auxiliary tank **112** can be provided to provide new refrigerant to the system in the event there is insufficient recycled refrigerant in tank **68**, auxiliary tank **100** or charging cylinder **82** to provide the proper amount of refrigerant charge to the air conditioning system **1**. In this situation liquid refrigerant from inverted tank **112** passes through tank valve **113** via line **103** to allow the refrigerant to flow therein. In another preferred embodiment heater band **111** is positioned about tank **112** to insure that liquid refrigerant will flow from tank **112** to tank **68**.

One particular advantage that the recycling system of this invention has over all prior art systems is its flexibility to meet any recharging or recycling situation. For example, when the recharging cylinder has become hot causing the pressure in cylinder cavity **91** to become greater than that in tank cavity **67**, it would normally not be possible to move recycled refrigerant from tank cavity **67** to cylinder cavity **91**. However, with the preferred embodiments of this invention the pressure in cylinder cavity **91** can be lowered sufficiently by switching on compressor **45** and opening solenoid **96** thereby allowing recycled refrigerant to flow through line **89** since solenoid valve **88** has also been opened.

Although heater bands **40**, **58**, **97**, **111** and **116** have been described as being external of the various oil separators, tanks and cylinders, any conventional heating means can be employed.

In another preferred embodiment a dual illuminated push button switch assembly **132** is provided having two illuminated push button switches **124** and **125** electrically connected to circuit breaker **126**, coil **131** and rotary cam switch **115** in a manner so that at rotary cam switch settings **2–8** pushing illuminated (preferably green light) operator **129** energizes coil **131** to provide electrical power to rotary cam switch **115** and illuminated operators **129** and **130**. In the preferred electrical circuit shown in FIG. **2** electrical power to rotary cam switch **115** can in an emergency be cut off by pressing illuminated (preferably red light) operator **130**. This will result in the immediate termination of whatever operation is then occuring.

In another preferred aspect of this invention all major functions of the assembly can be electrically controlled from a **13** single rotary cam switch, such as a Square D Type K rotary cam switch. This is accomplished by the electrical circuit schematic shown in FIG. **2**. In this preferred embodiment rotary cam switch **115** is provided with eight switch settings which correspond to the following functions: setting 1—off function; setting 2—recycle function; setting 3—recovery function; setting 4—refrigerant transfer from tank **68** to charging cylinder **82** function; setting 5—refrigerant transfer from charging cylinder **82** to air conditioning system **1**;

setting 6—refrigerant transfer from tank **68** to auxiliary tank **100**; setting 7—refrigerant transfer from auxiliary tank **100** or tank **112** to tank **68**; and setting 8—activate vacuum pump **25** function.

A typical power receptacle **117**, such as a **120** volt power receptacle, is provided having its plus side connected to circuit breaker **126**. In turn the plus side of circuit breaker **126** is connected to the plus side of transformer **121**, oil separator band heaters **40**, **58** and **116**, relay switch **127** (which is normally open unless activated by coil **131**), and to relay reset switch **125** (which is normally open).

When circuit breaker **126** is turned on and rotary switch **115** has been set to setting 1 no electrical circuit is completed to provide electrical power to any of the electrical devices in the electrical circuit except those independent of switch **115**; e.g. heater bands **40**, **58** and **116**, as well as float switch **120**, transformer **121**, relay **122**, and lamp switch **123**.

At setting 2, electrical power is provided to condenser fan motor **118** by closing contacts 1-2 of switch **115**, to compressor motor **119** by closing contacts **3-4**, to solenoid so by closing contacts 5-6, and switch assembly **132** by closing contacts 17-18.

At setting **3**, electrical power is provided to condenser fan motor **118** by closing contacts 1-2, to compressor motor **119** by closing contacts 3-4 and to switch assembly **132** by closing contacts 17-18.

At setting **4**, electrical power is provided to condenser fan motor **118** by closing contacts 1-2, to compressor motor **119** by closing contacts 3-4, to solenoid **96** by closing contacts 7-8, to solenoid **88** by closing contacts 9-10 and switch assembly **132** by closing contacts 17-18.

At setting 5, electrical power is provided to condenser fan motor **118** by closing contacts 1-2, to charging cylinder band heater **97** by closing contacts 11-12 and switch assembly **132** by closing contacts 17-18.

At setting 6, electrical power is provided to condenser fan motor **118** by closing contacts 1-2, to compressor motor **119** by closing contacts 3-4 and switch assembly **132** by closing contacts 17-18.

At setting 7, electrical power is provided to condenser fan motor **18** by closing contacts 1-2, to compressor motor **119** by closing contacts 3-4, to solenoid **80** by closing contacts 5-6, to auxiliary tank band heater **111** by closing contacts 13-14 and switch assembly **132** by closing contacts 17-18.

At setting 8, electrical power is provided to condenser fan motor **118** by closing contacts 1-2, to charging cylinder band heater **97** by closing contacts 11-12, to vacuum pump **25** by closing contacts 15-16 and switch assembly **132** by closing contacts 17-18.

When changing from one setting to another, it is preferred that power is disrupted to switch **115**, and lighted (preferably green) switch **125** must be turned on again.

There are of course other alternate embodiments which are obvious from the foregoing descriptions of the invention which are intended to be included within the scope of the invention as defined by the following claims.

What I claim is:

1. An assembly for recovering and recycling used refrigerant from an air conditioning system which comprises:

(a) a first cleaning assembly comprising:

(i) an oil separator operatively connectable to said air conditioning system to receive contaminated refrigerant from said air conditioning system and structured to remove oils from said contaminated refrigerant, and

(ii) a filter means operatively connected to said oil separator to receive the treated refrigerant from said oil separator and said structured to remove solid particles and moisture from said treated refrigerant to form a cleaned refrigerant gas stream;

(iii) a valve assembly having a sealable first connection means attachable to said air conditioning system to receive said used refrigerant, and a sealable second connection means attachable to said oil separator to allow said used refrigerant to operatively pas to said oil separator, and a sealable third connection means operatively attachable to a vacuum pump to permit evacuation of said air conditioning system;

(b) a compressor, having a compression chamber with a low pressure inlet and a high pressure outlet, operatively connected at said low pressure inlet to said filter mean to cause said cleaned refrigerant to pas through said filter means, and then to cause said cleaned refrigerant gas stream to pass through said low pressure inlet into said compression chamber, and structured to compress said cleaned refrigerant gas stream to for ma cleaned refrigerant high pressure gas stream to force said cleaned refrigerant high pressure gas stream out of said compression chamber through said high pressure outlet;

(c) a condenser operatively connected to said compressor to receive said cleaned refrigerant high pressure gas stream and having cooling means to condense said cleaned refrigerant high pressure gas steam to form a liquid cleaned refrigerant containing stream;

(d) means operatively connected to said condenser to receive said liquid cleaned refrigerant containing stream in a manner to remove non-condensible gas contaminates from said liquid cleaned refrigerant containing stream to form liquid recycled refrigerant; and

(e) a metering means comprising a charging cylinder forming a cavity provided with an inlet opening for receiving liquid recycled refrigerant from a storage means, and an outlet opening for discharging said liquid recycled refrigerant from the charging cylinder cavity, said metering means being operatively connected to discharge, through a second solenoid valve to said first cleaning assembly, gas refrigerant contained a vapor space located in the charging cylinder cavity whenever said liquid recycled refrigerant is received from said storage means through a third solenoid valve operatively connected to a sealable outlet opening of said storage means.

2. An assembly for recovering and recycling used refrigerant from an air conditioning system which comprises:

(a) a first cleaning assembly comprising:

(i) an oil separator operatively connectable to said air conditioning system to receive contaminated refrigerant from said air conditioning system and structured to remove oils from said contaminated refrigerant, and

(ii) a filter means operatively connected to said oil separator to receive the treated refrigerant from said oil separator and said structured to remove solid particles and moisture from said treated refrigerant to form a cleaned refrigerant gas stream;

(iii) a valve assembly having a sealable first connection means attachable to said air conditioning system to receive said used refrigerant, and a sealable second connection means attachable to said oil separator to allow said used refrigerant to operatively pass to said oil separator, and a sealable third connection means operatively attachable to a vacuum pump to permit evacuation of said air conditioning system;

(b) a compressor, having a compression chamber with a low pressure inlet and a high pressure outlet, operatively connected at said low pressure inlet to said filter means to cause said cleaned refrigerant to pass through said filter means, and then to cause said cleaned refrigerant gas stream to pass through said low pressure inlet into said compression chamber, and structured to compress said cleaned refrigerant gas stream to form a cleaned refrigerant high pressure gas stream and to force said cleaned refrigerant high pressure gas stream out of said compression chamber through said high pressure outlet;

(c) a condenser operatively connected to said compressor to receive said cleaned refrigerant high pressure gas stream and having cooling means to condense said cleaned refrigerant high pressure gas stream to form a liquid cleaned refrigerant containing stream;

(d) means operatively connected to said condenser to receive said liquid cleaned refrigerant containing stream in a manner to remove non-condensible gas contaminates from said liquid cleaned refrigerant containing stream to form liquid recycled refrigerant; and

(e) a metering means operatively connected to a storage means to receive from said cavity through a sealable outlet opening of said storage means at least some of said liquid recycled refrigerant, and to discharge at a pre-determined density to said air conditioning system a pre-determined amount of the received liquid recycled refrigerant.

3. An assembly according to claim **2** wherein said metering means comprises a charging cylinder forming a cavity provided with an inlet opening for receiving liquid recycled refrigerant from said storage means, and an outlet opening for discharging said liquid recycled refrigerant from the charging cylinder cavity, and wherein a means to prevent said cavity from being filled with said liquid recycled refrigerant above a predetermined amount is operatively attached to said charging cylinder.

4. An assembly according to claim **3** wherein a heating means is operatively connected to said charging cylinder to heat said liquid recycled refrigerant in the charging cylinder cavity to a pre-determined temperature.

5. An assembly according to claim **4** wherein said heating means has sufficient heating capacity to heat said liquid recycled refrigerant in the charging cylinder cavity to at lest 112° F. and is provided with a pressure limiting device to prevent said heating means from heating said liquid recycled refrigerant above about 112° F.

6. An assembly for recovering and recycling used refrigerant from an air conditioning system which comprises:

(a) a first cleaning assembly comprising means to receive and then to remove liquid and solid contaminates from said used refrigerant to form a cleaned refrigerant gas stream;

(b) a compressor, having a compression chamber with a low pressure inlet and a high pressure outlet, operatively connected at said low pressure inlet to said means to cause said cleaned refrigerant to pass through said means, and then to cause said cleaned refrigerant gas stream to pass through said low pressure inlet into said compression chamber, and structured to compress said cleaned refrigerant gas stream to form a cleaned refrigerant high pressure gas stream and to force said cleaned refrigerant high pressure gas stream out of said compression chamber through said high pressure outlet;

(c) a condenser operatively connected to said compressor to receive said cleaned refrigerant high pressure gas stream and having cooling means to condense said cleaned refrigerant high pressure gas stream to form a liquid cleaned refrigerant containing stream;

(d) a storage means comprising:

(i) a tank forming a cavity having a gas contaminate area located in the upper section of said cavity and having a liquid recycled refrigerant area located in the lower section of said cavity, said storage means having an inlet opening operatively connected to said condenser and positioned to receive said liquid cleaned refrigerant containing stream into said cavity so as to allow any liquid cleaned refrigerant in said liquid cleaned refrigerant containing stream to locate in said liquid recycled refrigerant area and to allow any gas contaminates in said liquid cleaned refrigerant containing stream to locate in said gas contaminate area, said storage means having a sealable outlet opening positioned to allow discharge of any liquid recycled refrigerant in said liquid recycled refrigerant area, and

(ii) tank cooling means operatively attached to said tank to cool said cavity, comprising:

(A) a first solenoid valve operatively attached to said tank to allow said liquid recycled refrigerant from said sealable outlet opening to pass,

(B) an adjustable constant pressure externally equalized expansion valve having a high pressure opening operatively attached to said first solenoid valve and having a low pressure opening, and

(C) a length of tubing, a section of which is positioned in said cavity, one end of said tubing being operatively attached to said low pressure opening and the opposite end of said tubing being operatively connected to said low pressure inlet of said compression chamber, and

(e) a purge means operatively connected to said storage means to purge said gas contaminate area of sufficient amounts of said gas contaminates which may have collected in said cavity to achieve less than a pre-determined maximum amount of said gas contaminates in said recycled liquid refrigerant.

7. An assembly for recovering and recycling used refrigerant from an air conditioning system and recharging the recycled refrigerant to the same or another air conditioning system which

(a) a first cleaning assembly comprising means to receive and then to remove liquid and solid contaminates from said used refrigerant to form a cleaned refrigerant gas stream;

(b) a compressor, having a compression chamber with a low pressure inlet and a high pressure outlet, operatively connected at said low pressure inlet to said means to cause said cleaned refrigerant to pass through said means, and then to cause said cleaned refrigerant gas stream to pass through said low pressure inlet into said compression chamber, and structured to compress said cleaned refrigerant gas stream to form a cleaned refrigerant high pressure gas stream and to force said cleaned refrigerant high pressure gas stream out of said compression chamber through said high pressure outlet;

(c) a condenser operatively connected to said compressor to receive said cleaned refrigerant high pressure gas stream and having cooling means to condense said cleaned refrigerant high pressure gas stream to form a liquid cleaned refrigerant containing stream;

(d) a storage means forming a cavity having a gas contaminate area located in the upper section of said cavity and having a liquid recycled refrigerant area located in the lower section of said cavity, said storage means having an inlet opening operatively connected to said condenser and positioned to receive said liquid cleaned refrigerant containing stream into said cavity so as to allow any liquid cleaned refrigerant in said liquid cleaned refrigerant containing stream to locate in said liquid recycled refrigerant area and to allow any gas contaminates in said liquid cleaned refrigerant containing stream to locate in said gas contaminate area, said storage means having a sealable outlet opening positioned to allow discharge of any liquid refrigerant in said liquid recycled refrigerant area,

(e) a purge means operatively connected to said storage means to purge at pre-determined times said gas contaminate area of at least some of said gas contaminates which may have collected in said cavity, and

(f) a metering means operatively connected to said storage means to receive from said cavity through said sealable outlet opening at least some of said liquid recycled refrigerant, and to discharge at a pre-determined density to said air conditioning system a pre-determined amount of the received liquid recycled refrigerant.

8. An assembly according to claim 7 wherein said metering means comprises a charging cylinder forming a cavity provided with an opening for receiving liquid recycled refrigerant from said storage means or for discharging said liquid recycled refrigerant from the charging cylinder cavity, and further provided with a means attached to said charging cylinder to prevent said cavity from being filled with said liquid recycled refrigerant above a pre-determined amount.

9. An assembly according to claim 8 wherein said metering means is operatively connected to said compressor to discharge, through a second solenoid valve to said first cleaning assembly, gas refrigerant contained in a vapor space located in the charging cylinder cavity whenever liquid recycled refrigerant is received from said storage means through a third solenoid valve operatively connected to said sealable outlet of said storage means.

10. An assembly according to claim 8 wherein said metering means is operatively connected to discharge liquid refrigerant from said charging cylinder cavity through a second solenoid valve to said first cleaning assembly.

11. An assembly according to claim 9 wherein a heating means is operatively connected to said charging cylinder to heat said liquid recycled refrigerant in the charging cylinder cavity to a pre-determined temperature.

12. An assembly according to claim 11 wherein said heating means has sufficient heating capacity to heat said liquid recycled refrigerant in the charging cylinder cavity to at least 112° F. and is provided with a pressure limiting device to prevent said heating means from heating said liquid recycled refrigerant above about 112° F.

13. An assembly according to claim 6 or 7 which further comprises a gauge assembly comprising:

(a) a first gauge attached to said storage means and having a sensing means operatively positioned with respect to said cavity to sense the actual pressure in said cavity, and having a recording means operatively connected to said sensing means to visually display the amount of said actual pressure and

(b) a bulb-capillary temperature gauge having a capillary sensing means containing a fluid being of the same composition as the refrigerant desired to be charged in said air conditioning system, and operatively connected to said storage means to directly sense the actual temperature in said cavity, and having a converted recording means operatively connected to said capillary sensing means to visually display the amount of a pre-determined pressure associated with said actual temperature.

14. An assembly according to claim 13 wherein said first gauge and said bulb-capillary temperature gauge are positioned at about the same level in said cavity to measure the pressure and temperature, respectively, of the gases in said cavity.

15. An assembly according to claim 13 wherein said recording means and said converted recording means are structured to display the same range of possible pressures, and wherein each are provided with a pointer means to indicate on the display of the range of possible pressures the amount of said actual pressure and the amount of a pre-determined pressure associated with said actual temperature, respectively.

16. An assembly according to claim 15 wherein said refrigerant is R-12 and wherein said range of possible pressures is about 0–300 psig.

17. An assembly for recovering and recycling used refrigerant from an air conditioning system which comprises:

(a) a first cleaning assembly comprising means to receive and then to remove liquid and solid contaminates from said used refrigerant to form a cleaned refrigerant gas stream;

(b) a compressor, having a compression chamber with a low pressure inlet and a high pressure outlet, operatively connected at said low pressure inlet to said means to cause said cleaned refrigerant to pass through said means, and then to cause said cleaned refrigerant gas stream to pass through said low

pressure inlet into said compression chamber, and structured to compress said cleaned refrigerant gas stream to form a cleaned refrigerant high pressure gas stream and to force said cleaned refrigerant high pressure gas stream out of said compression chamber through said high pressure outlet;

(c) a condenser operatively connected to said compressor to receive said cleaned refrigerant high pressure gas stream and having cooling means to condense said cleaned refrigerant high pressure gas stream to form a liquid cleaned refrigerant containing stream;

(d) a storage means forming a cavity having a gas contaminate area located in the upper section of said cavity and having a liquid recycled refrigerant area located in the lower section of said cavity, said storage means having an inlet opening operatively connected to said condenser and positioned to receive said liquid cleaned refrigerant maintaining stream into said cavity so as to allow any liquid cleaned refrigerant in said liquid cleaned refrigerant containing stream to locate in said liquid recycled refrigerant area and to allow any gas contaminates in said liquid cleaned refrigerant containing stream to locate in said gas contaminate area, said storage means having a sealable outlet opening positioned to allow discharge of any liquid recycled refrigerant in said liquid recycled refrigerant area,

(e) a gauge assembly for determining the amount of gas contaminates in said cavity, said gauge assembly comprising:

(i) a first gauge attached to said storage means and having a sensing means operatively positioned with respect to said cavity to sense the actual pressure in said cavity, and having a recording means operatively connected to said sensing means to visually display the amount of said actual pressure and

(ii) a bulb-capillary temperature gauge having a capillary sensing means containing a fluid being of the same composition as the refrigerant desired to be charged in said air conditioning system, and operatively connected to said storage means to directly sense the actual temperature in said cavity, and having a converted recording means operatively connected to said capillary sensing means to visually display the amount of a pre-determined pressure associated with said actual temperature, and

(f) a purge means operatively connected to said storage means to purge at pre-determined times said gas contaminate area of at least some of said gas contaminates which may have collected in said cavity.

18. An assembly according to claim **17** wherein said first gauge and said bulb-capillary temperature gauge are positioned at about the same level in said cavity to measure the pressure and temperature, respectively, of the gases in said cavity.

19. An assembly according to claim **18** wherein said recording means and said converted recording means are structured to display the same range of possible pressures, and wherein each are provided with a pointer means to indicate on the display of the range of possible pressures the amount of said actual pressure and the amount of a pre-determined pressure associated with said actual temperature, respectively.

20. An assembly according to claim **19** wherein said refrigerant is R-12 and wherein said range of possible pressures is about 0–300 psig.

21. An assembly according to claim **6**, **7** or **17** wherein said means to remove liquid and solid contaminates comprises:

(i) an oil separator operatively connectable to said air conditioning system to receive contaminated refrigerant from said air conditioning system and structured to remove oils from said contaminated refrigerant,

(ii) a filter operatively connected to said oil separator to receive treated refrigerant from said oil separator and structured to remove solid particles and moisture from said treated refrigerant to form said cleaned refrigerant gas stream, and

(iii) a valve assembly having a sealable first connection means attachable to said air conditioning system to receive said used refrigerant, and a sealable second connection means attachable to said oil separator to allow said used refrigerant to operatively pass to said oil separator, and a sealable third connection means operatively attachable to a vacuum pump to permit evacuation of said air conditioning system.

22. An assembly according to claim **21** wherein said assembly further comprises a metering means having an inlet opening operatively connected to said storage means to receive from said cavity through said sealable outlet opening at least some of said liquid recycled refrigerant, and to discharge through a sealable outlet opening of the metering means at a pre-determined density to said air conditioning system through a second valve assembly a pre-determined amount of the received liquid recycled refrigerant.

23. An assembly according to claim **6** or **17** wherein said assembly further comprises a metering means comprising a charging cylinder forming a cavity provided with an inlet opening for receiving liquid recycled refrigerant from said storage means, and an outlet opening for discharging said liquid recycled refrigerant from the charging cylinder cavity, said metering means being operatively connected to discharge, through a second solenoid valve to said first cleaning assembly, gas refrigerant contained in a vapor space located in the charging cylinder cavity whenever said liquid recycled refrigerant is received from said storage means through a third solenoid valve operatively connected to said sealable outlet opening of said storage means.

24. An assembly according to claim **6** or **17** which further comprises a metering means operatively connected to said storage means to receive from said cavity through said sealable outlet opening at least some of said liquid recycled refrigerant, and to discharge at a pre-determined density to said air conditioning system a pre-determined amount of the received liquid recycled refrigerant.

25. An assembly according to claim **24** wherein said metering means comprising a charging cylinder forming a cavity provided with an inlet opening for receiving liquid recycled refrigerant from said storage means, and an outlet opening for discharging said liquid recycled refrigerant from the charging cylinder cavity, and wherein a means to prevent said cavity from being filled with said liquid recycled refrigerant above a pre-determined amount is operatively attached to said charging cylinder.

26. An assembly according to claim 25 wherein a heating means is operatively connected to said charging cylinder to heat said liquid recycled refrigerant in the charging cylinder cavity to a pre-determined temperature.

27. An assembly according to claim 26 wherein said heating means has sufficient heating capacity to heat said liquid recycled refrigerant in the charging cylinder cavity to at least 112° F. and is provided with a pressure limiting device to prevent said heating means from heating said liquid recycled refrigerant above about 112° F.

28. An assembly according to claim 7 or 17 wherein said storage means comprises:

(a) a tank forming said cavity, and

(b) tank cooling means operatively attached to said tank

29. An assembly according to claim 28 which further comprises a sealable, pressurized auxiliary storage means comprising:

(a) a container forming a cavity and provided with a sealable first opening operatively connected to said sealable outlet opening of said storage means and

(b) a valve assembly operatively connected to said first opening to permit liquid refrigerant to flow through said first opening or to seal said first opening upon a predetermined condition, and

(c) a line shutoff valve operatively attached to said valve assembly through which said liquid refrigerant flows.

30. An assembly according to claim 29 wherein:

(a) said container is further provided with a sealable second opening,

(b) a second valve assembly is operatively connected to said second opening to permit gaseous refrigerant to flow through said second opening, or to seal said second opening upon set conditions,

(c) a second line shutoff valve operatively attached to said second valve assembly through which said gaseous refrigerant flows from said container.

31. An assembly according to claim 28 wherein said tank cooling means comprise:

(a) a first solenoid valve operatively attached to said tank to allow said liquid recycled refrigerant from said sealable outlet opening to pass,

(b) an adjustable constant pressure externally equalized expansion valve having a high pressure opening operatively attached to said first solenoid valve and having a low pressure opening, and

(c) a length of tubing, a section of which is positioned in said cavity, one end of said tubing being operatively attached to said low pressure opening and the opposite end of said tubing being operatively connected to said compression chamber.

32. An assembly according to claim 6, 7 or 17 wherein said means to remove liquid and solid contaminates comprises:

(i) an oil separator operatively connectable to said air conditioning system to receive contaminated refrigerant from said air conditioning system and structured to remove oils from said contaminated refrigerant, and

(ii) a filter operatively connected to said oil separator to receive the treated refrigerant from said oil separator and structured to remove solid particles and moisture from said treated refrigerant to form said cleaned refrigerant gas stream.

33. An assembly according to claim 32 wherein said oil separator further comprises a closed container having a cavity for receiving said contaminated refrigerant, a stainless steel wool mesh screen positioned in said cavity at a location to cause contact with said contaminated refrigerant, a valve means operatively connected to the bottom section of said cavity to permit the drainage of any oil collected in said cavity, a heating means attached to said closed container to heat said contaminated refrigerant in said cavity, and an oil indicator means to indicate the amount of said oils contained in said oil separator.

34. An assembly according to claim 32 wherein said means to remove liquid and solid contaminates further comprises:

(iii) a valve assembly having a sealable first connection means attachable to said air conditioning system to receive said used refrigerant, and a sealable second connection means attachable to said oil separator to allow said used refrigerant to operatively pass to said oil separator, and a sealable third connection means.

35. An assembly according to claim 6, 7 or 17 which further comprises a shut-off switch having means to determine the level of said liquid cleaned refrigerant in said cavity and operatively connected to said compressor to prevent said compressor from operating either when said level is above a first pre-determined level or below a second pre-determined level.

36. An assembly according to claim 35 wherein a by-pass switch is operatively connected to said compressor to override the shutdown of the operation of said compressor by said shut-off switch.

37. An assembly according to claim 6, 7 or 17 wherein a moisture indicating means is operatively attached to said first cleaning assembly to receive said cleaned refrigerant gas stream from said first cleaning assembly and to indicate the presence of any moisture in said cleaned refrigerant gas stream.

38. An assembly according to claim 6, 7 or 17 wherein a compressor lubricating oil assembly operatively connected to said compressor, comprises:

(a) an oil separator-return means forming an oil collecting cavity provided with (i) an inlet opening operatively connected to said high pressure outlet to allow said cleaned refrigerant high pressure gas stream to enter said oil collecting cavity, (ii) a first outlet opening operatively connected to said compression chamber to allow oil separated from said cleaned refrigerant high pressure gas stream in said oil collecting cavity to be returned to said low pressure inlet of said compression chamber, and (iii) a second outlet opening to allow said cleaned refrigerant high pressure gas stream to pass from said oil collecting cavity; and

(b) a second cleaning assembly comprising means operatively connected to said oil separator to receive said cleaned refrigerant high pressure gas stream from said second outlet opening and to remove liquid and solid contaminates from said cleaned refrigerant high pressure gas stream in the event of an upset condition.

39. An assembly according to claim 38 wherein said means operatively connected to said oil separator-return means to receive said cleaned refrigerant high pressure gas stream from said second outlet opening and to remove liquid and solid contaminates from said cleaned refrigerant high pressure gas stream comprises:

(i) an oil separator operatively connectable to said oil separator-return means to receive cleaned refrigerant high pressure gas stream from said second outlet opening and structured to remove oils from said cleaned refrigerant high pressure gas stream, and

(ii) a filter operatively connected to said oil separator to receive treated refrigerant from said oil separator and structured to remove solid particles and moisture from the received cleaned refrigerant high pressure gas stream.

40. An assembly according to claim **6**, **7** or **17** wherein a moisture indicating means is operatively attached to said condenser to receive said liquid cleaned refrigerant containing stream in a manner to indicate the presence of any moisture in said liquid cleaned refrigerant containing stream.

41. An assembly according to claim **6**, **7** or **17** wherein a storage means to visually display the level of liquid recycled refrigerant in said cavity.

42. An assembly according to claim **41** wherein said liquid level indicating means is a sight glass.

43. An assembly according to claim **6**, **7** or **17** which further comprises an auxiliary storage means comprising:

(a) a container forming a cavity and provided with a sealable first opening operatively connected to said sealable outlet opening of said storage means and

(b) a valve assembly operatively connected to said first opening to permit liquid refrigerant to flow through said first opening or to seal said first opening upon a predetermined condition, and

(c) a line shutoff valve operatively attached to said valve assembly through which said liquid refrigerant flows from said container.

44. An assembly according to claim **43** wherein a heating means is operatively connected to said auxiliary storage means to heat any refrigerant in said auxiliary storage means.

45. An assembly according to claim **43** wherein a filter means is operatively connected between said sealable first opening and the cavity of said storage means to receive the refrigerant from the auxiliary storage means and is structured to remove solid particles and moisture from the refrigerant before it is discharged into the cavity of the storage means.

46. An assembly for recovering and recycling used refrigerant from an air conditioning system and recharging the recycled refrigerant to the same or another air conditioning system which comprises:

(a) a first cleaning assembly comprising means to receive and then to remove liquid and solid contaminates from said used refrigerant to form a cleaned refrigerant gas stream;

(b) a compressor, having a compression chamber with a low pressure inlet and a high pressure outlet, operatively connected at said low pressure inlet to said means to cause said used refrigerant to pass through said means, and then to cause said cleaned refrigerant gas stream to pass through said low pressure inlet into said compression chamber, and structured to compress said cleaned refrigerant gas stream to form a cleaned refrigerant high pressure gas stream and to force said cleaned refrigerant high pressure gas stream out of said compression chamber through said high pressure outlet;

(c) a condenser operatively connected to said compressor to receive said cleaned refrigerant high pressure gas stream and having cooling means to condense said cleaned refrigerant high pressure gas stream to form a liquid cleaned refrigerant containing stream;

(d) a storage means comprising:

(i) a tank forming a cavity having a gas contaminate area located in the upper section of said cavity and having a liquid recycled refrigerant area located in the lower section of said cavity, said storage means having an inlet opening operatively connected to said condenser and positioned to receive said liquid cleaned refrigerant containing stream into said cavity so as to allow any liquid cleaned refrigerant in said liquid cleaned refrigerant containing stream to locate in said liquid recycled refrigerant area and to allow any gas contaminates in said liquid cleaned refrigerant containing stream to locate in said gas contaminate area, said storage means having a sealable outlet opening positioned to allow discharge of any liquid recycled refrigerant in said liquid recycled refrigerant area, and

(ii) tank cooling means operatively attached to said tank to cool said cavity comprising a first solenoid valve operatively attached to said tank to allow said liquid recycled refrigerant from said sealable outlet opening to pass, an adjustable constant pressure externally equalized expansion valve having a high pressure opening operatively attached to said first solenoid valve and having a low pressure opening, and a length of tubing, a section of which is positioned in said cavity, one end of said tubing being operatively attached to said low pressure opening and the opposite end of said tubing being operatively connected to said compression chamber,

(e) a purge means operatively connected to said storage means to purge at pre-determined times said gas contaminate area of at least some of said gas contaminates which may have collected in said cavity,

(f) a metering means operatively connected by a third solenoid valve to said storage means to receive from said cavity through said sealable outlet opening at least some of said liquid recycled refrigerant, and to discharge through a three-way valve at a pre-determined density to said air conditioning system a pre-determined amount of the received liquid recycled refrigerant, and

(g) an auxiliary storage means comprising:

(i) a container forming a cavity and provided with a sealable first opening operatively connected to said sealable outlet opening of said storage means and

(ii) a valve assembly operatively connected to said first opening to permit liquid refrigerant to flow through said first opening or to seal said first opening upon a pre-determined condition, and

(iii) a line shutoff valve operatively attached to said valve assembly through which said liquid refrigerant flows from said container.

47. An assembly according to claim **46** wherein said metering means comprises a charging cylinder forming a cavity provided with an inlet opening for receiving liquid recycled refrigerant from said storage means, and an outlet opening for discharging said liquid recycled refrigerant from the charging cylinder cavity and having a first heating means operatively connected to said charging cylinder to heat said liquid recycled refriger-

ant in the charging cylinder cavity to a pre-determined temperature, and wherein a means to prevent said cavity from being filled with said liquid recycled refrigerant above a pre-determined amount is operatively attached to said charging cylinder.

48. An assembly according to claim **47** wherein said compressor, said first heating means, the condenser cooling means, and said first, second and third solenoid valves are electrically controlled; and wherein said assembly further comprises an electrical process control switch having separate switching positions operatively electrically connected to said compressor, said first heating means, said condenser cooling means, and said first, second and third solenoid valves to permit each operation performed by said assembly to be controlled by said electrical process control

49. An assembly according to claims **1**, **6**, **7**, **17** or **46** which further comprises a manifold assembly having:

(i) a manifold body provided with a sealable cavity for receiving refrigerant, said manifold body provided, with four sealable passageways which connect said sealable cavity to the outside surface of said manifold body,

(ii) a first line having one of its ends attached to a first one of said four sealable passageways and having its opposite end attachable to a high pressure port of said air conditioning system in a manner to permit flow of refrigerant to and from said cavity to and from said high pressure port,

(iii) a second line having one of its ends attached to a second one of said four sealable passageways and having its opposite end attachable to a low pressure port of said air conditioning system in a manner to permit flow of refrigerant to and from said sealable cavity to and from said low pressure port,

(iv) a third line having one of its ends attached to a third one of said four sealable passageways and recycled refrigerant, and

(v) a fourth line having one of its ends attached to a fourth one of said four sealable passageways and having its opposite end attachable to said first cleaning assembly.

50. An assembly according to claim **49** wherein said fourth line's opposite end is further attachable to a vacuum pump.

51. An assembly according to claim **49** wherein

(a) a first three-way valve is operatively connected to said third line in a manner to permit flow of liquid recycled refrigerant from more than one source to said manifold assembly, and

(b) a second three-way valve is operatively connected to said fourth line in a manner to permit flow of refrigerant from said manifold assembly to said first cleaning assembly or to a vacuum pump.

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